REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 39-45 and 47-77 are presently pending in this case. Claims 57-77 are withdrawn. Claims 39, 47, 54, and 56 are amended and Claim 46 is canceled without prejudice or disclaimer by the present amendment. As amended Claims 39, 47, 54, and 56 are supported by the original claims, no new matter is added.

In the outstanding Official Action, Claims 39-41, 53, and 55 were rejected under 35 U.S.C. §102(b) as anticipated by Deguchi et al. (European Patent Application Publication No. 0 844 319, hereinafter "Deguchi"); Claims 42-52, 54, and 56 were rejected under 35 U.S.C. §103(a) as unpatentable over Deguchi; and Claims 42-56 were rejected under 35 U.S.C. §103(a) as unpatentable over Deguchi in view of Ekstrom et al. (U.S. Patent No. 6,914,025, hereinafter "Ekstrom").

Claim 56 is amended to correct an informality.

With regard to the rejection of Claim 39 as anticipated by Deguchi, Claim 39 is amended to include the subject matter of Claim 46. Accordingly, the rejection of Claim 39 is believed to be overcome, and the rejections of Claim 46 are traversed below with respect to Claim 39.

Amended Claim 39 recites in part:

> a layer of CVD diamond grown onto a diamond loaded (DL) material, the DL material comprising a mass of diamond particles in a matrix and having a surface with exposed diamond particles on which the layer of CVD diamond is grown,
>
> wherein the layer of CVD diamond is bonded to the exposed diamond particles of the DL material at least in part by epitaxy, and ***the grown layer of CVD diamond has an exposed surface with at least 30% of the exposed surface being occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond.***

Deguchi describes a process for preparing a diamond film.[1] The outstanding Office Action conceded that Deguchi is silent with respect to the subject matter of Claim 46,[2] and did not rely on any part of Ekstrom for this subject matter.[3] However, the outstanding Office Action concluded that this subject matter (1) is not critical, and (2) would be obvious to discover by routine experimentation, citing *In re Aller* and *In re Boesch*.[4]

Initially, it is respectfully noted that in heat spreading applications, the thermal conductivity needs to be highest immediately adjacent to the point at which heat is generated. The larger the diamond grains at the exposed surface of the CVD diamond layer, the better the heat spreading properties. Fine grained materials, in contrast, have much lower thermal conductivities. The present specification in page 8, paragraph 2 discusses the desirability of having a large number of large particles in the growth (exposed) surface of the CVD diamond layer. Thus, it is respectfully submitted that the subject matter of amended Claim 39 is critical and thus should be given patentable weight.

With respect to the second assertion, is respectfully noted that *In re Antonie* holds that a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also MPEP §2144.05(II)(B). As the outstanding Office Action conceded that Deguchi is silent with respect to the subject matter of Claim 46, and did not cite any portion of Ekstrom for this subject matter, neither Deguchi nor Ekstrom can describe that an exposed surface of a grown layer of CVD diamond occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond is a

[1]See Deguchi, abstract.
[2]See the outstanding Office Action at page 3, lines 16-18.
[3]See the outstanding Office Action at page 3, lines 16-18.
[4]See the outstanding Office Action at page 3, line 19 to page 4, line 6.

result effective variable. Therefore, the subject matter of amended Claim 39 ***cannot*** be considered a matter of routine experimentation.

In fact, Deguchi describes a method of producing a diamond firm on a silicon substrate in which ultrasonic seeding, it is claimed, results in the "embedding" of diamond particles in the surface of the silicon and that epitaxial growth occurs on these particles. Deguchi further describes that the number density of nuclei on the surface should very high ($>10^{10}$ cm^{-2}) to promote the adhesion of the diamond film to the surface of the silicon substrate.[5] A nucleation density of $> 10^{10}$ cm^{-2} implies that the typical grain size at the nucleation surface is about $1/10^5$ cm or about 0.1 μm. This is a very fine grain size.

The high nucleation density is the key part of Deguchi's invention (which is the ability to make very thin layers of diamond, that are a few pm thick, that are essentially gap-free and, because of the very high nucleation density, very fine grained).

Thus, the Deguchi CVD diamond layer has diamond grains with a size of about 0.1 μm[6] and thickness of no more than about 0.5 pm[7]. Thus, the grain size of Deguchi is at most 20% of the thickness, whereas in the invention defined by amended Claim 39, the grain size is required to be at least 400% of the thickness, a factor 20 times larger than Deguchi.

Moreover, it is respectfully submitted that the nuclei of Deguchi are not "embedded" in the surface on which they are located. The particles of Deguchi are only 0.1 pm across. Considering the mechanics of impact, i.e. that smaller particles are less likely to embed than large particles: the ultrasonic vibration subjects a particle to an accelerating force that is proportional to its mass and therefore its volume. However the drag on the particle, which will oppose the accelerating force, is proportional to its surface area. Since the volume increases faster than the area, larger particles will be accelerated more than smaller particles

[5]See, e.g., Deguchi, column 2, lines 28-31.
[6]See Deguchi, abstract and column 4, line 41.
[7]See Deguchi, column 3, line 57.

in the same environment and therefore will have more kinetic energy relative to their mass than smaller particles and will be more likely to embed than smaller particles. As the applicants are not aware of any evidence in the literature supporting the embedding of larger particles which would be much easier to find on a substrate surface than smaller particles, it is reasonable to conclude, in the absence of contrary evidence, that the particles of Deguchi are not embedded. The only evidence of "embedding" in Deguchi is a schematic drawing. Further, even if there was some "embedding" of the diamond particles in the silicon substrate surface of Deguchi, that is surface diamond loading only and not a diamond loaded material through its bulk, as in the claimed invention. Accordingly, Deguchi does not inherently teach or suggest "a layer of CVD diamond" as defined in amended Claim 39.

Finally, Ekstrom does not cure the deficiencies of Deguchi. First, Ekstrom does not suggest the use of his diamond loaded material as a substrate for CVD diamond growth. Second, even if one was to grow a CVD diamond layer on the Ekstrom material, that diamond layer must be a fine grained diamond layer of Deguchi.

Therefore, as Deguchi and Ekstrom do not explicitly or inherently teach or suggest the subject matter of amended Claim 39, and the subject matter of amended Claim 39 ***cannot*** be considered a matter of routine experimentation, it is respectfully submitted that neither Deguchi nor Ekstrom teaches or suggests "a layer of CVD diamond" as defined in amended Claim 39. Consequently, amended Claim 39 (and Claims 40-45 and 47-53 dependent therefrom) is patentable over Deguchi and Ekstrom.

Amended Claim 54 recites in part:

> a layer of DL material having major surfaces on each of opposite sides thereof; and
> a layer of CVD diamond in thermal contact with each of the major surfaces, with either one or both of the CVD diamond layers being bonded at least in part by epitaxy to exposed diamond particles of the DL material,
> wherein ***the layer of CVD diamond has an exposed surface with at least 30% of the exposed surface being***

occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond.

As noted above, Deguchi and Ekstrom do not explicitly or inherently teach or suggest a "the layer of CVD diamond has an exposed surface with at least 30% of the exposed surface being occupied by diamond grains with a grain size of at least four times a thickness of the layer of CVD diamond," and this subject matter ***cannot*** be considered a matter of routine experimentation. Consequently, amended Claim 54 (and Claims 55 and 56 dependent therefrom) is also patentable over Deguchi and Ekstrom.

Accordingly, the pending claims are believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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